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OPPORTUNITIES FOR YOUNG MEN IN SCIENCE[1]

OPPORTUNITIES IN BOTANY

SOME of us have been assured by those who have had to do with the program that the sharers in this symposium are not to feel themselves fettered by the specific limitations of their assigned topics.

Hence my liberty in asking first why we should be concerned at all in any special effort to increase interest in science work as a profession. General interest in science is another matter. The aim of this symposium, however, appears to be to point out why a choice of their life work from the various branches of science is a desirable choice for young men to make.

It may be reasonably inferred, if only from the remarks made this morning in the discussion upon what shall be the dues of this organization (so happily placed at one dollar), that we have nothing very great in the way of financial compensation to offer. For that very reason, if we are good economists, should we not be the last to encourage more strenuous competition for the apparently limited number of real competences which exist for the sustenance of life workers in science? Yet we are most cheerfully engaged in doing that very thing. Though there may be far from enough to go around in generous portions, let us by all means have more in at the feast. There may be compensation in the extra-prandial proceedings.

An editorial in a recent science peri-

[1] From a symposium at the organization meeting of the Illinois State Academy of Science.

odical estimates that fewer than five thousand persons in the United States are professionally engaged in science investigation or in the teaching of science up to the research point. Of these it reckons that fewer than one thousand should be counted real contributors. What are one thousand among eighty million? We must accept the fact that several European nations excel us in this respect.

It comes to mind that our inferiority herein may be due as much to absence in the minds of the educated public of the aims and actual work in science progress as to anything else. Herein is, perhaps, the best reason for such a symposium and for such an organization as has just been perfected. These words of Matthew Arnold seem appropriate:

> The great men of culture are those who have had a passion for diffusing, for making prevail, for carrying from one end of society to the other, the best knowledge, the best ideas of their time; who have labored to divest knowledge of all that was harsh, uncouth, difficult, abstract, professional, exclusive; to humanize it, to make it efficient outside the clique of the cultivated and learned.

The point is, then, that our real science workers are both too few and too remote from the general public. They work very largely in another world than the one of common conception. From the world of common knowledge they must, perhaps always, remain aloof. But may not the real value of their work be at least adequately conceived?

In Europe the magazines and even the shop windows furnish evidence of the popular interest in science progress. Wherever the forward movement is most active you catch a quick reflection of it in the popular press. There the public is said to be really much concerned of late with what is sometimes called the "passing of Darwinism." What does the American public know or seriously care about Darwinism being on its "deathbed"? Here our editors shun the rather dry and obscure authorities in favor of picturesquely-worded and sensation-charged celebrities; and, reciprocally, the authorities shun the editors.

Yet are we not ready to admit that the modern aspect of "national progress" depends very largely upon the number of properly qualified persons who are engaged in science research, and, perhaps as much, upon the extent to which the general public follows their advance?

Does not the fault for this large American gap between science workers and the general public lie much with the scientists who have held aloof; who have rarely taken it as part of their task properly to popularize the problems on which they are at work; who have let misrepresentation go almost unchecked; who have done much to form a sort of aristocracy of their own kind?

But, wherever the fault lies, we must lessen the gap. The constitution we have just adopted explicitly commits us to this. Unless there develops more popular interest in the great truth search, in this and its many other aspects; unless there develops more feeling of personal responsibility in finding out for one's own self, and less of being easily satisfied with the first plausible explanation, then the national peril for lack of "clean truth" to which Dr. Chamberlin made reference this morning is surely not very difficult to perceive; a reference which, by the way, has some responsibilty for this digression from my topic.

Specifically, of the opportunities in botany, we can say that the demand for trained botanists continues to exceed the supply. Such demand is, of course, especially for young men ready to begin their service at compensation less than the theoretical value of the service rendered. Fur-

ther, it is almost exclusively a demand for men to whom the service means at least as much as the compensation. But, as such, it is unquestionably a vigorous and growing demand.

The most extensive employer of young botanists in America is the United States government, and we are very reliably informed that the various bureaus of the Department of Agriculture are in positive need of more men adequately trained in plant morphology and physiology than they can find. Such training is usually sufficiently well attained in two or, at most, three years of graduate study.

It is becoming increasingly difficult to differentiate between botanists pure and simple and special students of agriculture. Yet we are loath to lose good men through a mere juggling of terms, as botanist into agronomist or something like, even though the latter cashes in better. So, among present-day opportunities in botany should not be overlooked the one of being botanist in fact only, with sedulous avoidance of a name which suggests nothing of the large cash values upon which this section of the profession, under its many aliases, may justly pride itself.

For teachers of botany the market is still brisk, though the upward tendency is not perhaps so marked as in other lines of demand. Doctors of philosophy in botany are commanding beginning salaries in teaching positions which average about fifty per cent. more than those offered eight years ago. These are in the main, of course, positions of collegiate or equivalent rank. It is for teachers of lesser training that the demand has shown a barely perceptible falling off. But this is more than offset by the increasing demand for teachers of agriculture for the rural high schools. What botany in some quarters is threatened with losing as a high school subject, agriculture has already more than gained. Since the question has become very largely one of teaching much the same subject in a more efficient way, we may expect that botany, in this respect, will be a graceful loser.

In the Philippines a "practical" botanist is wanted in every province, of which there are more than thirty, to take in charge the immensely important educational side of the problem, especially from the standpoint of the agricultural possibilities. No stereotyped problem here, nor meager compensation therewith!

The opportunities for amateur work in connection with the academy should, perhaps, receive a word of comment. Apart from its large educational function, I take it that the contributory work of the academy will confine itself, in the main, within state boundaries. With such limitation, and assuming the cooperation of a considerable and favorably distributed number of persons, an ecologically annotated geographic catalogue is perhaps the first task which suggests itself. Such work for such an organization has the peculiar virtue of simplicity in its individual parts, absolute necessity for extensive cooperation, and the very large value of the final symposium. The humblest sharer in the work may be thoroughly satisfied that his part is quite as important as almost any other part.

Of intensive area work in ecology, Cowles's work on the dunes and Gleason's quite recent study of sand-flat areas of the Illinois River forcefully suggest the considerable number of similar, yet untouched and equally attractive, problems within the state.

The native prairie plants, made historic by their striking floral aspects alone, remain undisturbed in but few and restricted areas. The salvation of a strip of native prairie large enough to reveal the original

ecological factors may be already impracticable, but the academy may well have in mind the establishment of a state garden of the native plants.

Fresh acres in garden and field will be given each year to the new experiments in plant breeding, and here, too, the amateur may well lend a hand, though our agronomical friends may question whether such a suggestion is pertinent among points for amateur *botanists*.

In closing, I beg to submit a definite suggestion for which I must again seek excuse in that incontestable statement of our president this morning, that in lack of clean truth there lies national peril.

Nowhere in our educational literature is the absence of clean truth more conspicuous than in the nature-study books which are in common use in the graded schools. Nowhere has the unauthorized word had wider play or more credulous following. Untrained teachers have had nature study thrust upon them and have turned with avidity toward whatever seemed to offer help. Composites of sentiment and inaccuracy have been liberally supplied as "supplementary reading."

The suggestion is that there be issued in the name and under the direct auspices of the academy a series of leaflets upon science topics suitable for use as material in nature study and geography. Such topics should be treated especially from the standpoint of the state in so far as they lend themselves suitably to such treatment. Such leaflets should be available to the public schools at low cost. An educational editor, perhaps a member of the standing committee upon publication, might have in charge the apportionment of topics to members willing to cooperate, and ample discretion in editing to suit the educational needs in view should be allowed such an editor.

In objection, the point may be raised that in its very infancy the academy would be rash to venture to finance such a scheme. It may be confidently stated, however, that funds sufficient for such purpose would be at the disposal of the academy in case such proposal meets its good will.

A similar service has been and continues to be rendered by the Cornell Nature Study and Agricultural Leaflets.

John G. Coulter

OPENINGS FOR CHEMISTS

Eighteen years ago, as I was sitting in a café in Munich one evening, talking to a young Englishman, he said to me "England has the present but America has the future." He meant, of course, that while England at that time stood in the forefront of progress, industrially as well as politically, the conditions were such in America, both in our command of natural resources and in the character of our people, as to make it practically certain that the lead in both respects must go to America in a not far-distant future.

In the years which have passed since that time, this prophecy has been going on toward a rapid fulfillment. As an illustration, we may take the manufacture of iron. At that time, more iron was manufactured in England than in any country in the world, but within a few years afterwards the production in America exceeded that in England, and it is now very much greater here than there.

In this increased industrial activity in America, chemists have played and are playing a very important part. In this very industry of the manufacture of iron and steel, twenty-five years ago very few chemists were employed in this country, but to-day chemists are required not only in the large establishments where steel is produced, but in foundries and factories

of all kinds where large amounts of iron are used.

What has happened in the iron industry has happened also in a great variety of other industries. To speak of the different lines in which chemists are to-day employed would be almost to give a list of the important industries of the country. There is in these and in chemical work in general a rapidly increasing diversity. During the past year the American Chemical Society has established an abstract *Journal* which intends to give an account of all new work in chemistry which is published in the world. The abstracts in this journal are classified in thirty divisions, and this illustrates the great variety of industries and directions in which chemists are interested.

The amount of knowledge which has been accumulated in chemical science is so great that I feel safe in saying that the detailed knowledge in this science is greater in amount than the whole mass of scientific knowledge in all sciences fifty years ago. I do not, of course, mean that the value of this chemical knowledge is greater than the value of the scientific knowledge fifty years ago, but merely that its amount is greater, and I say this for the purpose of emphasizing the diversity of interests among chemists.

It is estimated that there are about eight thousand chemists employed in the United States at the present time. One of the previous speakers has referred to an estimate that there are only five thousand scientific men in the United States. While I do not suppose that all of the eight thousand chemists can be properly classed as scientific men in the sense in which the term was used by the former speaker, I am inclined to think that this number indicates that there are many more scientific men in the United States than would correspond to that estimate. The increase in the number of chemists during the past twenty-five years has been very largely occasioned by the employment of chemists in the industries. A quarter of a century ago, nearly all of the chemists in the United States were engaged in teaching, while to-day the majority are undoubtedly working in industrial lines.

But it is not merely in the industries that the number of chemists has greatly increased during this period. Thirty years ago, very few educational institutions could have been found which had more than three or four chemists on their staff. In the institution with which I am connected, the staff includes more than thirty chemists who are engaged in teaching or research, and I do not think that the institution is unusual in this regard.

Very large numbers of chemists have also been required in recent years by agricultural experiment stations and by government bureaus. Since the enactment of the pure-food law especially, the demand for chemists to fill positions in connection with the bureau of chemistry has largely exceeded the supply of suitable men, and during the past summer many of those who have been called upon to answer inquiries for chemists to fill positions have been compelled to reply that they had no suitable candidate to recommend.

W. A. NOYES

UNIVERSITY OF ILLINOIS

OUTLOOK FOR YOUNG MEN IN GEOLOGY

PROBABLY our academy can do no one thing more useful than to encourage the young men and women of talent who are looking forward to a career in science. By this is not meant a deliberate effort to divert men and women from other work to ours, but rather the holding out of a helping hand to those whose inclinations are toward a scientific career, but who hesitate

for fear that there is either no work or no place for them.

It is well known that men of science receive relatively poor financial returns for their work. Capable and industrious workers make a good living, but rarely are able to accumulate wealth. This is true of geologists as of others, and I for one am by no means sure that a change in this regard would bring to our profession any larger number of men of the highest talent and devotion. Be that as it may, the best which can be now offered to the hesitating young man is a good living while he does his work. The opportunities for making his way are found in these lines of activity: (*a*) teaching, (*b*) survey work and (*c*) industrial positions.

Geology is seldom taught in high schools and secondary schools though there is a strong and increasing demand for teachers in physiography. This affords an excellent opening for beginners. In the colleges, universities and mining schools geology is taught as frequently as the other sciences and there are, accordingly, as many positions open.

The largest number of professional geologists in this country are connected for a whole or a part of their time with official surveys or bureaus. The greatest of these is the U. S. Geological Survey, which in the season just closed maintained ninety-three geological field parties. These each included from one to three geologists or aids. In addition many of the topographic and other field parties were engaged upon work so closely related to geology as to afford suitable opportunity for service on the part of beginners at least. In the forest service and in other branches of government work still other men are employed. Thirty-one of the states now have state geologists or equivalent officers and sustain more or less geological work. This work varies greatly in character from refined paleontologic investigations to the registering of mining prospectuses and bureau of information work. In some cases only a few hundred dollars are appropriated for the summer field work, perhaps, of the professor of geology at the university, and in others several thousand dollars are given annually and ten or a dozen field parties maintained. State survey work, where available, offers peculiar advantages to the beginner, since on account of the small force there is less specialization.

In mining and industrial work geologists are finding an increasing number of opportunities. Many railways, mining companies, development companies, etc., now employ one or more geologists. This indicates a welcome change of attitude in the public recognition of our work, but for the time being it cripples survey work by drawing away many of the best men. These positions are eagerly sought and pay relatively well, but usually offer only restricted opportunities for research work and often prohibitive conditions as regards publication. It is to be hoped that in time these restrictions will largely disappear.

Granted, then, that properly equipped and willing workers may rest assured of positions being open to them, the vital question remains as to the work to be done. To some extent, in geology, pioneer conditions have passed. In our portion of the world geologic mapping on some scale has very generally been done. In much of Canada, in Alaska, in parts of Mexico and in most of South America pioneer conditions, as regards geology, still prevail. Very little of either Africa or Asia has been carefully studied so that as regards systematic work alone the bulk of our task is still before us. If also we measure the work from the point of view of development of ideas, the task is even more

attractive. Geology has heretofore been mainly in the qualitative state. Its workers have been busy developing the processes involved and have had only the crudest means of elimination when it was necessary to test one hypothesis against another. As Van Hise has pointed out, we have now at least entered into the quantitative stage and this means nothing less than the reduction to an orderly basis of the accumulated observations of all the years past. As we accomplish this we shall change our science from an inexact one of hypothesis to an exact one of law; and we shall then stand on an equal basis as regards certainty with our associates of the physical and mathematical sciences. This is certainly a field large enough and important enough to attract the best energies of any man or woman. If our academy shall help to put the right man in touch with his problem and the means of solving it, we shall quickly justify its existence.

H. FOSTER BAIN

URBANA, ILL.

OUTLOOK FOR YOUNG MEN IN PHYSICS

Mr. Chairman and Gentlemen: Sudden and unexpected as this call is, I feel bound by the courteous manner in which the invitation is extended to respond.

The opportunities offered by the science of physics may for convenience, at least, be grouped under the four following heads:

(1) *Research.*—To him who finds his "manifest destiny" in investigation, the recent discoveries of physical science have vastly multiplied the opportunities for new discoveries. To illustrate; when Hertz in the autumn of 1888 showed us how to produce electric waves, a tremendous field was opened to research. The various properties of waves of different lengths under different conditions all had to be studied. Every year some new domain of this kind is made ready for occupation by the earnest and serious student.

(2) *Applied Physics.*—For him who has that practical turn of mind which characterized Franklin and has yet preserved an interest in pure science (which also characterized Franklin) there is always a rare opportunity. In the autumn of 1831 Faraday not only discovered the induction of electric currents, but also actually made an electric motor and an electric generator about the same time. But it was not until the late sixties that the dynamo became a commercial success. This delay is typical of the mental hysteresis which generally separates discoveries in physical science from their industrial applications.

It was seven years after Hertz's discovery of electric waves before Marconi showed them to have commercial value; and it has taken practically twenty years to employ them for transatlantic messages. In these intervening periods lies great opportunity for the alert "practical mind."

(3) *Engineering.*—Nearly all the great engineering concerns of America are looking for more men than they can find of the broadly trained type—men who are acquainted, *at first hand,* with the general principles of physical science. A man may know every machine in the shop of an engineering firm and yet not know how to design a new mechanism to meet a new want or a new circumstance. What is demanded to-day is, therefore, not so much an acquaintance with present-day practise as a thorough mastery of the fundamental principles of engineering—and these are mainly the principles of physics.

(4) *Teaching.*—The high salaries which engineering concerns are offering to men well trained in physical science and to men of executive ability have had the effect of leaving vacant many excellent teaching positions in physics. The door is wide

open for him who enjoys this line of work and who is willing to leave behind all hope of opulence.

HENRY CREW
NORTHWESTERN UNIVERSITY

OUTLOOK FOR YOUNG MEN IN ZOOLOGY

IN the ten minutes allotted, I shall attempt to answer six questions of special interest to those who are planning to enter zoology as a profession. Through the kindness of Professors Mark, Minot, Comstock, Sedgwick, Reighard, Lillie, Conklin, Ward and Jennings, who have generously responded to my appeal for information, I am in a position to state the outlook for young men somewhat from the standpoint of their experience. As far as possible, the answers to the questions relating to the topic assigned me will be given in the words of the above-named zoologists.

1. *How do the chances for getting good positions compare with those of a decade ago?*

All of the zoologists who have expressed an opinion on this question agree that the chances are much better than they were a decade ago. Professor Comstock writes: "I should say that they are much better. It is only fair to emphasize, however, that the man who takes up work along these lines purely as a financial venture, apart from other considerations, will be disappointed. And I should say also that a large part of the demand for entomologists in recent years has been due largely to the great increase of this kind of work in the Department of Agriculture at Washington. Many men have found places with Dr. Howard or have taken places vacated by others who have gone to Dr. Howard. If the government support of this kind of work were to cease it would make a great difference in the chances for getting good positions."

Dr. Mark writes: "Have been surprised that the demand has increased so rapidly. This has been more noticeable in the field of comparative anatomy than in other lines during the past five or ten years."

According to Dr. Minot, "There is great difficulty in getting any men for positions in anatomical and zoological laboratories, and I believe that for a few years the opportunities will be unusually good. But for heaven's sake, do not encourage any mediocrities to go into science. If you can, have them Oslerized at sixteen."

Dr. Conklin thinks that the chances of a young man's going at once from his graduation to the headship of a department are probably not so great now "as they were a decade ago."

Dr. Jennings says that "it is difficult to get the men needed for positions in zoology, and this is true all along the line from assistantships up to full professorships."

2. *Is it ever necessary for a man with a doctor's degree to rest on his oars for a year because no desirable college or university position is open to him?*

The reply of Dr. Lillie is typical of the answers given to this question: "In the course of a good many years several of our doctors of philosophy have accepted positions in high schools and normal schools; in such cases it has usually been a matter of preference with them. So far as I know, there has never been a case of one of our doctors of philosophy being obliged to go without a position for even a year."

According to Dr. Jennings, "many excellent positions have gone to men without the doctorate."

3. *Does the number of desirable positions equal the number of candidates?*

Dean Ward writes that "there have been more desirable positions in zoology which have come to my attention in the last five years than I could have filled three times over if every one of my advanced students

had been ready to consider such opportunities. We have not been able to furnish enough teachers to supply the college demand, nor enough collectors and workers for museum and government positions. The expansion in connection with college teaching, the demand for more men in old institutions and for new men in those recently founded has exceeded the supply."

Dr. Reighard writes that in his department "the number of applications for candidates to fill positions in biology and zoology has for some years fallen far short of the supply. I have had about ten applications for the present year and have been able to fill *none* of them with men directly from my laboratory. Two were, however, filled with men who have recently been here. These were applications for *men* and for positions above secondary-school grade."

4. *Has the number of men entering zoology as a profession increased or decreased?*

"There certainly has been no increase in proportion to demand," says Dr. Jennings. Dr. Reighard, however, writes that "the number of students in advanced classes with the definite purpose of preparing to teach in institutions above secondary-school rank, is *less*."

5. *Are any new fields opening up for zoological students?*

According to Dr. Sedgwick "The demand for men in physiology and sanitary biology is particularly brisk, especially in the latter subject. For several years it has been impossible to meet the demands for young men properly equipped to fill positions in sanitary or industrial biology."

Dr. Reighard writes that "to a certain extent new fields are opening up: (*a*) I have had two applications within a month for men to fill positions in experimental research work particularly breeding experiments, in agricultural colleges, under the Adams act. (*b*) There is a slowly increasing demand for men to undertake museum work. We have difficulty in keeping good museum men here. (*c*) Some of the older educational institutions are reorganizing their zoological departments and expanding them. (*d*) The normal schools are seeking men (and women) with the newer, ecological training, capable of organizing work along 'natural study' lines. I have had a couple of calls of this sort within a few months."

According to Dr. Jennings, "Some new fields are opening for zoological students. The various research institutions recently established take a number. The Adams act recently enacted by Congress promises to call a number into the service of state experiment stations, and has begun to do so already. I should judge that many more educational institutions require competent men in this line, or a greater number of them, than was the case a few years ago. On the whole, I should say that the prospects are excellent in zoology at present, particularly for the investigator."

6. *Is the demand for zoologists likely to continue as great as at present?*

There seems to be good reason to believe that the conditions which have kept up the demand for the past decade will continue in the next. Even financial depression such as that of the present time does not seem to diminish the number of students in higher institutions of learning nor the demand for additional instructors. The policy of the General Education Board and of the Carnegie Foundation will tend not only to open up new positions for younger men, but also to make college and university positions more attractive.

From such considerations, we need not hestitate to encourage the exceptional man whose tastes lead him in that direction to

enter zoology as a profession, with the well grounded hope of attaining such a position as his talents deserve.

H. V. Neal

Knox College,
Galesburg, Ill.

THE CHEMICAL EDUCATION OF THE ENGINEER[1]

The academic education of the civil engineer is a thing of yesterday; or rather, it is a thing of to-day. Yesterday it was not. I use the word, "civil" in its original sense. Balbus was, without doubt, a military engineer. The great roads of antiquity were built by soldiers. In the Motherland, yours and mine, there were no roads till the Roman legions made them. On this continent, the canoe and the blazed trail were sufficient till Braddock's three hundred axemen hewed their way through the forest from the sea to Fort Duquesne, and our Governor Simcoe connected Lake Ontario with the lake that bears his name by the military road which, in imitation of the old Roman Watling Street, he called, as we call it still—Yonge Street.

But steam changed all this. With steam came railways; and with railways came the civil and the mechanical engineer, and to them has been added, in our own day, the electrical engineer. At first, the civil and the mechanical engineer learned their trade, like everybody else in those days, by apprenticeship. They learned to play the fiddle by playing the fiddle, without any lectures on the physical and the physiological bases of harmony or any exercises "zur Fingerfertigkeit." And grand musicians they were, those old masters who wrote their opera on staves of iron ruled across two continents; whose treble was the shriek of the locomotive, and whose bass was the roar of the blast furnace, whose choruses were sung by the toilers of the nations, and whose libretto was the record of the world's progress.

It is a truism that genius often gains its end by bursting barriers and breaking rules. But for all that, we have come to think that education will not hinder the genius, and will surely help the engineer.

It is noteworthy that France, where one word stands for both genius and engineering, led the way in this matter. Engineering education dates from the foundation of the École des Ponts et Chausées. Germany followed; then America, like one born out of due time, but now become the greatest of the Apostles. Nay, at last, even my countrymen, clothed as they are with a contempt for theory which throws off the undulations of the intellectual ether more completely than polished nickel, backed by a conservatism more impermeable than infusorial earth, even Englishmen are giving signs of viscosity; and British public opinion is flowing forward with a motion like that of a glacier, slow, indeed, but sure and irresistible.

We agree then that the engineer shall be educated. But shall chemistry form one of the subjects of his education? Assuredly yes. For what is an engineer? He is a man who devises and supervises the construction and use of engines—contrivances—that is, for yoking the forces of nature to the service of man; and what are chemistry and physics but the ordered and methodical study of these forces and of their action on the materials of which machines are constructed and upon which they work.

I am speaking to-day as a chemist to chemists, and it is safe to say that we are all pretty well agreed as to the kind of teaching that is best for the professional chemist, whether his career is to be technical or academic.

[1] Read at the Chicago meeting of the American Chemical Society.

So too, there are certain sufficiently obvious considerations which would guide us in shaping a chemical course for a mining engineer. Chemistry is chemistry even if you call it metallurgy and assaying; and those of us who have helped to frame a curriculum in chemical engineering know that the great problem is to keep the engineering twin from smothering his chemical brother.

About all this a great deal has been written and a great deal has been said, and we are, I think, most of us, so far, in substantial agreement.

But what about the chemical education of the civil and mechanical engineer? We may at once admit that chemical problems form but a small proportion of those which confront him. It is true that the combustion of fuel, the incrustation of boilers, and the rusting of metals, the preservation of timber, the setting of cement, the action of explosives, all involve questions of chemistry, and their consideration forms part of the daily work of the engineer. But in many such cases he can accept the results of previous investigations without troubling himself about the way they were obtained, and in others he can call in the chemist to his aid. The engineer is not a chemist, and for him chemistry must be reckoned as one of his "culture subjects." It is exactly here that the difficulty of the teacher begins. He is called upon to teach chemistry to boys who are not going to be chemists, who have no wish to become chemists and who ought not to be encouraged to think that they are being made chemists.

On the one hand, he must make his subject sufficiently interesting to attract to it a due share of that energy upon which there are so many other and, in the student's judgment, more pressing calls; and, on the other hand, he must not lead the student to suppose that, after attending a few lectures and performing a few laboratory experiments, he will be able to pose as a chemical expert.

This is a real difficulty; and it is all the greater because chemistry is looked upon by the public as a utilitarian subject—a study which is supposed to have, as of course it has, a practical bearing upon daily life.

One of my teachers used to illustrate to his class the value of the study of mineralogy by saying to them: "Suppose a farmer brought you a bit of hard yellow mineral and said to you: 'Sir, what is this? You have attended a course of lectures on mineralogy, can you tell me if it is any good? It occurs in great abundance on my farm. Is it gold or what is it?'" And he went on to show how, with the aid of a watch glass, the student could dissipate the golden dreams of the credulous husbandman.

One of my colleagues, who is a graduate of Oxford, somewhat grudgingly admitted that it was desirable, in a new country such as Canada, that a young man should learn chemistry, because he might through its aid discover a silver mine.

The notion that chemistry is a study which has a high value as a mental training, as a means of broadening and deepening the mental outlook—in a word, as a means of culture on a par with mathematics and languages and history—is still very far from the point of view of the man in the street.

Now, the undergraduate is the son of the man in the street; and he brings to college his father's point of view, his father's prejudices, and his father's limitations—together with a cocksurety that is all his own.

Our first task then is to give the young engineer the chemist's point of view. Our

point of view is ever changing, and our view of truth changes with it and is always incomplete. It is the tangent to the curve that represents the evolution of our knowledge of the truth, and it coincides with that curve only at that infinitesimal interval of time that we call now. As we look into the future, it diverges more and more widely from the truth, and we can only keep in the true path by continually shifting our view-point and continually changing our views. This is the first thing we should teach our students. But our present view of the truth, though certainly incomplete, is not necessarily false. If our data are reliable, if our measurements are accurate, if our calculations are correct, it does really represent the facts as we now know them. It is real knowledge. It will become out of date with the lapse of time, but it will not be contradicted; it will not be exploded. This is the next thing to be taught. The recognition of these two cardinal principles constitutes the scientific habit of mind. This is essentially the difference between the mental attitude of the man of science and that of the man in the street. Our first duty is to impress this way of looking at things on the plastic minds of our pupils, not by precept only, but by example, by illustration, by reiteration till it becomes a part of their nature.

But it is not enough to give a boy the chemist's point of view. We must also try, as far as time and opportunity allow, to make him see the things the chemist sees. We must get him to look beneath the surface of the forms of matter that surround him and discern, at least in some dim way, the throbbings of the living forces within them and around them.

And here let us beware of serving up knowledge in individual platters. Do not let the student get into his head that there is one chemistry of the metals and another of the non-metals, or that organic chemistry and inorganic chemistry have any real existence except as guide cards in a catalogue.

The student's time is so short and so crowded with other studies that only a few types can be chosen. But let those types be selected so as to cover, as far as may be, the whole field; let them be as typical as possible, and make the student understand that they are types. Thanks to the great Russian Pilot, this is an easy task now in comparison with what it used to be in the days when some of us launched our bark on the yet uncharted sea.

Above all things, let us see to it that the student never for one moment flatters himself with the notion that what we require him to know is all there is of chemistry that is worth knowing! Let us make it abundantly clear to him that we are only teaching him to read the language of chemistry and that the selections we set before him are only exercises in translation—not a corpus poetarum.

When I speak of teaching the student to read the language of chemistry, I am using no empty metaphor. This is the kernel of the whole matter. What we have to do is just this—to teach him to *read* chemistry; to interpret chemical phrases; to give him clear notions as to the meaning of the conventions by which the chemist expresses his ideas.

This, as I have said before, is mental training of a high order. But it is more than that. The utilitarian side of the question must not be overlooked any more than the cultural aspect. The time will come, sooner or later, when the engineer will want to find out what is known about the chemistry of some subject in which he is interested. Very likely his need will be urgent; it is certain his time will be scant. If he has had the education I speak of, he

will know where to look for information; and he can use it when he finds it. If he meets a phrase he can not construe, he will know how to use his dictionary. A statement couched in chemical language, or symbols, will not make him shut the book like a nineteenth-century chemist confronted with a sign of integration.

Nothing will arouse and retain the student's interest so effectually as frequent references to those points of contact between theory and practise, where the abstractions we are trying to teach him become concrete in the problems he will have to face.

And here let me say what I have hinted before, that it is a mistake, I am sure, to keep organic chemistry a sealed book to the engineer. If we consider the various applications of chemistry to daily life and to industry, it is surprising to note how many of them are concerned with the chemistry of the carbon compounds. Fuel, explosives, sanitation, the decay and preservation of timber, pigments, oils, paper, textile industry, fermentation, the preparation and preservation of food, all have to do with organic chemistry. Let any one read a list of patents, or the classification of abstracts in the *Journal of the Society of Chemical Industry,* and this will be made abundantly clear.

It may be objected that in the time at his disposal the student can only acquire a smattering of this great subject, and that such a smattering is worse than useless. I readily grant the first contention, but I emphatically deny the second. If by the abusive term "smattering" we mean a little knowledge, then that smattering is dangerous only when it carries with it unconsciousness of its own littleness, and I hope I have made myself sufficiently clear as to the importance of keeping always before the student his own limitations.

The cure for superficiality, that bugbear of the pedant, is not to blindfold the eyes, but to train the eyesight, and the student whose mental vision is thus sharpened will not only be able to see clearly the things that lie before him and about him on the threshold of our science, but he it is who will most readily discern the vastness and the richness of the territory at whose frontier he stands; and he who will most humbly and most surely walk in any of its paths along which his business or his pleasure calls him.

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SCIENTIFIC BOOKS

The Integrative Action of the Nervous System. By CHARLES S. SHERRINGTON. New York, Charles Scribner's Sons. 1906. Pp. xvii + 411. $3.50.

This volume contains the Silliman Memorial Lectures delivered at Yale University in 1904. In it the author focuses the work which he has carried on with such assiduity on the functions of the central nervous system considered as an organ for coordination. This side of nervous physiology has perhaps received less attention of late than the study of the activities of the individual nerve fiber or cell; though, to be sure, the author is able to refer to a long list of fellow workers, brought together into a valuable bibliography, among whom the most prominent are perhaps Exner and Goltz. It may, however, be safely said that the author's own contributions, in range and precision, now entitle him to rank at the head of students of this phase of the subject. The function of nervous tissue is, in a word, to conduct, and so to integrate—to enable the organism, in reacting on its environment, to act as a harmonious whole. To understand this function, one must, of course, penetrate the mystery of nerve conduction; but besides, and to some extent independent of that, one must know what are the paths of conduction and how they are interrelated. The present work is not concerned specially with topog-

raphy, but with the general facts of the interrelation of nerve paths.

The unit of coordination is the simple reflex, though this is itself an artificially simplified unit, "because all parts of the nervous system are connected together and no part of it is probably ever capable of reaction without affecting and being affected by various other parts." Nor does there exist, normally, such a thing as a resting condition, but every reflex supervenes upon a previous condition of reflex activity, and the modifications which it produces in that condition, by reinforcement and inhibition, are part and parcel of itself. The only adequate picture is that of a total reflex "pattern," which may analytically, though somewhat artificially, be considered as made up of a combination of simple reflexes, and which, in response to a stimulus, gives way to a new reflex pattern.

The simple reflex results from the joint action of three organs, the receptor or sense organ, the conductor, and the effector organ, which last is usually composed of muscular or glandular tissue. Regarding the receptor, it may be said that its function is to lower the threshold for a particular sort of stimulus—mechanical, chemical, photic—while simultaneously raising the threshold for other stimuli, so as to make possible different reactions to different classes of stimuli. The "pain" end organs form an exception to this rule, in that they are not specially adapted to any one physical stimulus, but respond to a stimulus of any sort which threatens injury to the part where the pain organ is located. In regard to the effector organ, it may be noted that it is not usually a single "muscle" in the anatomical sense, but may be either more or less than that.

It is, however, the conductor organ, especially that part of it that lies in the nerve centers, which gives to reflex action most of its variety and peculiarity. The characteristics of reflex conduction are brought out by contrasting it with the simpler conduction that is observed in nerve trunks. No less than eleven points of difference are detailed by the author. Some of these, such as the irreversibility of reflex conduction, as contrasted with the reversibility of conduction in nerve trunks, have long been recognized. The slowness of reflex conduction has also often been emphasized, but the author shows that the important difference here is rather the great dependence of speed in reflex conduction on the intensity of the stimulus. When the stimulus is strong, the conduction through the centers shows no special slowness, but when the stimulus is weak the reflex may be very much delayed. Again, in contrast with nerve trunks, which cease their activity promptly on the cessation of the stimulus, the reflex shows "after-discharge," which may be very prolonged when the stimulus is intense. The intensity of the reflex discharge is less closely dependent on the intensity of the stimulus than in the case of the nerve trunk or the muscle. The intensity of reaction of the nerve trunk is a continuous, and almost mathematical function of the intensity of the stimulus; but while something much like this may be said of some reflexes, in others the reaction remains practically constant for all intensities of the stimulus which are strong enough to elicit the reflex at all, and in still others the intensity of reaction remains constant for a considerable range of stimulus, only to make a sudden jump at a certain critical intensity. The threshold value for an effective stimulus is also much more variable in the reflex, since the internal condition of the reflex arc, as dependent on other simultaneous or preceding stimuli, is much more variable than that of the nerve trunk. Summation of subliminal stimuli is in the reflex arc much more likely than in the nerve trunk to produce a response; some reflexes can scarcely be elicited by a single momentary stimulus. When the stimulus is repeated, the rhythm of response in the nerve trunk follows closely that of the stimulus; whereas reflexes are apt to have a rhythm of their own, which is very slightly if at all controlled by that of the stimulus. The rhythm of different reflexes differs; in some it is as high as 12 per second; while in the dog's scratching reflex it is from 5 to 6, and in the "crossed stepping reflex" as low as

2.3 per second; and some reflexes consist of a single indivisible discharge. The rhythm of reflex discharge may be conceived as dependent on a "refractory phase" somewhere in the arc, similar in a broad way to the refractory phase of the heart. Whereas the refractory phase of a nerve trunk is not longer than .001 second, that of reflex discharge, varying in different reflexes, sometimes reaches as high as a second. The author has studied in a penetrating way the question of the seat of the refractory phase in the reflex arc. He shows that it can not lie in the muscle or motor neurone, nor in the sense organ or sensory neurone. It must lie in the central distributing and coordinating neurones, each of which has a refractory phase adapted in duration to the particular use of its reflex. Dependent on the central neurones is also the inhibition of muscular activity opposed to the reflex. As compared with the nerve trunk, the reflex arc is also much more susceptible to fatigue, shock, deprivation of oxygen, and the action of anesthetics. It is interesting to observe that the author inclines to attribute all these peculiarities to the synapse or surface of separation between connecting neurones, and that he is favorable to their explanation by the physical properties of such a surface of separation, with its well-known power to produce partial, selective and polarized osmosis, and to restrict the movement of ions.

Passing from the simple reflex to the combination and coordination of reflexes, the author emphasizes first of all the principle of the "common path." Reflex arcs which start at different parts of the skin or other sense organs may converge so as to act on the same muscle or group of muscles. Thus, for example, the flexors of the joints of the hind limb can be aroused by stimulating almost any point on the skin of that limb, as well as from certain other parts of the surface and interior of the body. More than this, the same muscles are called into play in other reflexes, such as the scratching or the stepping reflexes, in which the time relations differ from those seen in the flexion reflex. It appears that the muscles, and with them the motor neurones which directly control them, can be aroused from various sources, and in ways that differ to a greater or less extent. The motor neurone, extending from the cord to the muscles, is therefore a common path, forming part of many reflex arcs. This fact is important in understanding coordination. There are reflexes which use the same muscles in the same way; they may be called allied reflexes. As they can make simultaneous use of the same muscles without interfering in any way with each other, they tend to reinforce each other. But there are reflexes which make use of a given set of muscles in ways that are incompatible with each other; one may require the inhibition of activity where the other requires the activity, or they both require activity, but in differing intensity or duration or rhythm. Such opposed reflexes could not, and do not, have simultaneous use of the same muscles. When the final path is open to one of them, it is closed to the other. And it is closed absolutely. If the stimuli appropriate to two antagonistic reflexes are simultaneously applied, one or the other appears, but never a compromise or average of the two, which would indeed be a useless reaction. If during the progress of one reflex the stimulus to another is applied, it may cause a cessation of the first and its replacement by the second, but the transition is abrupt; the first does not shade off into the second. If a stimulus, at first weak and arousing a local reflex, is gradually increased in intensity, the reflex tends to spread to other muscles and other members, but all the components so added to the original focal reflex are allied. The total reflex pattern at any moment—except for reflexes neutral to each other and without influence on each other, which may coexist to a very limited extent—may thus be analyzed into a combination of allied simple reflexes.

In the *succession* of reflexes quite a different principle comes into play, for it is commonly true that a reflex is followed by an antagonistic reflex. One frequent form of sequence is the return after a reflex to the posture

present before the reflex. This posture was itself reflex, and the return to it is by no means a passive movement, but is an active compensatory reaction. Very frequent in the spinal as well as in the intact animal are alternating reflexes, as stepping, scratching, etc. One of the most important original contributions of the author is the discovery of "successive spinal induction." A reflex which has been just preceded by an antagonistic reflex is found to be more readily excited than usual and to have greater energy. Inhibition of a reflex is "followed by a rebound to superactivity." As is the case in the heart muscle, so also in the spinal cord, the period of inhibition is not simply equivalent to a period of rest, but the activity of a reflex after active inhibition is greater than after repose. This fact has much to do with the orderly and adaptive sequence of an animal's movements.

Since it seldom happens that an animal is subjected to only one stimulus at a time, there is usually a competition between stimuli for control of the common paths. Prominent among the factors which make for success in this competition is intensity, the more intense stimulus having the advantage. But the intensity of the physical stimulus must be considered in connection with its location, for within the "receptive field" of a reflex, the more central portions give the reaction with weaker stimulation than do the more peripheral. Account must also be taken of other simultaneous or immediately preceding stimuli, since simultaneous stimuli that tend to arouse the same reflex, or preceding stimuli that have inhibited it, favor its appearance. The relative fatigue of different reflexes also influences the result of the competition. And, finally, the different *species* of reflexes are elicited with unequal ease. At the bottom of the scale stand the tonic reflexes, which very readily yield to others; and at the top, easiest to arouse, stand the reactions to injurious ("painful") stimuli, or to other stimuli which, considered from the point of view of sensation, have a strong affective tone.

In the chapters devoted to the brain, we find, besides the author's revision of the motor area, which is by now familiar, the observation that cortically originating movements are related in the same ways as spinal reflexes, being mutually allied, antagonistic or neutral. From the cortex, as in reflex excitation, the same stimulus which arouses a movement inhibits the opposing muscles. Also, the species of movements which can most easily be aroused by reflex paths can likewise be most easily aroused from the cortex, while such as can not be easily aroused reflexly are also very difficult of access by cortical stimulation. Flexions are in general easily aroused, extensions with difficulty. This does not mean that the "cortex is in touch with the flexors alone and not with the extensors. It means that the usual effect of the cortex on these latter is *inhibition*." The muscles of the body are not all on a par as regards reaction to stimuli, but may be broadly grouped into two systems, a *tonic* system, in which the extensors of the limbs are prominent, and a *phasic* system, in which the flexors are prominent. The muscles of the tonic system are usually kept in a condition of feeble tonic contraction, by means of which the posture of the animal is maintained. The phasic system responds to intercurrent stimuli; the posture is abandoned, inhibited, and a brief reaction, the first step in which is usually flexion, occurs, after which a compensatory movement brings back the previous posture. The stimuli which bring about tonus originate largely in the interior of the limbs and in the otic labyrinth. This system of sense organs is excited by mechanical means, especially by movements and tensions resulting from the contractions of the muscles and the movements and positions of the body. The chief center of this system, or, as we may call it in terms derived from the segmental conception of the nervous system, the ganglion of the system, is in the neighborhood of the principal sense organ belonging to it; this ganglion is the cerebellum. The cerebrum, similarly, may be considered as the ganglion of the great sense organs of the head, which have as their peculiar function the receiving of stimuli

from a distance. It is because they receive stimuli from and make possible reactions to a wider environment that these sense organs of the head dominate the whole system of phasic reactions; it is for the same reason that the cerebrum is dominant.

Bringing as it does the methods of minute and continued observation and of close reasoning into a field where the casual has been the rule, the book deserves, and requires as well, attentive study. Its importance to the physiologist is evident. The physician will find a number of special topics, such as the nervous symptoms of strychnin poisoning, of tetanus, and of shock, made the subject of careful investigation. The psychologist also will find a number of points of special interest, such as a study of certain fundamental aspects of binocular vision, an experimental test of the James-Lange theory of the emotions, and suggestive analogies between certain laws of spinal reflexes, such as reciprocal inhibition and successive induction, and familiar facts of attention and of sensation.

R. S. WOODWORTH

COLUMBIA UNIVERSITY

SCIENTIFIC JOURNALS AND ARTICLES

THE contents of the June number of *The American Journal of Science* are as follows: "Determination of the Molecular Weight of Radium Emanation by the Comparison of its Rate of Diffusion with that of Mercury Vapor," by P. B. Perkins; "Paleozoic Formations in Trans-Pecos, Texas," by G. B. Richardson; "Rectification Effect in a Vacuum Tube," by H. A. Perkins; "Life of Radium," by B. B. Boltwood; "New Occurrence of Proustite and Argentite," by F. R. Van Horn; "Occurrence of Gedrite in Canada," by N. N. Evans and J. A. Bancroft; "Iodometric Determination of Arsenic and Antimony Associated with Copper," by F. H. Heath.

THE editors of *The Botanical Gazette* announce that the price is to be advanced from $5.00 to $7.00 a year on July 1, 1908. They say: "You will easily realize that the financing of *The Botanical Gazette* has always been a problem, and you will not be surprised to hear that the University of Chicago has been obliged to contribute about $2,000 annually toward its support. It is not probable that the amount of this subsidy can be increased in the future, and at the same time the cost of production has been growing greater year by year. An interesting comparison has been instituted between *The Botanical Gazette* on the one hand and five leading botanical journals of Europe on the other in the matter of size and prices. It appears that on the average these journals give their readers 648 pages a year each, 12 plates, and 122 text figures, and the average price is $6.50. The *Botanical Gazette* on the other hand gives 945 pages, 45 plates, and 182 text figures, and its subscription price has been $5.00 in spite of the greater cost of manufacture in this country. The advice of numerous botanists has been sought and freely given, and with great unanimity their opinion favors the maintenance of the present standard of size with an increased subscription price; for it seems evident that the pressure of publication is increasing rather than diminishing. In view of the whole situation, it has been decided to increase the annual subscription to $7.00, in the belief that this represents a fair charge for the service rendered. The new rate will be applied to subscriptions begun or renewed with the July number, 1908, and thereafter."

SOCIETIES AND ACADEMIES

THE CHICAGO SECTION OF THE AMERICAN MATHEMATICAL SOCIETY

THE twenty-third regular meeting of the Chicago Section of the American Mathematical Society was held at the University of Chicago, on Friday and Saturday, April 17–18, 1908.

Professor G. A. Miller, vice-president of the society and chairman of the section, presided at all of the sessions. In opening the meeting he referred to the great loss of the society in the recent death of Professor Heinrich Maschke and appointed a committee, consisting of Professors E. B. Van Vleck, Alexander

Ziwet and H. E. Slaught, who presented the following resolutions on behalf of the section:

Whereas, in the death of Professor Heinrich Maschke the Chicago Section of the American Mathematical Society suffers the loss of one of its most honored, influential and beloved members, your committee on behalf of the section hereby expresses its deep appreciation of his services and character.

From the first organization of the Chicago Section until the present session Professor Maschke has been one of its most active and inspiring members. By his genial qualities, his unusual sympathy as a teacher, his integrity and intellectual honesty, he has won and held the affection of those who have known him. By his ability as an investigator he has contributed greatly to the development of productive mathematical scholarship in the formative period of the society, and in his own person he has exemplified the influence of German scholarship which has contributed so potently to this development. In the death of Professor Maschke the section for the first time feels the loss of one of its leaders.

The following papers were read before the section:

Dr. C. H. Sisam: "On a locus determined by concurrent tangents."

Professor W. B. Ford: "On the integration of the equation

$$a_0(x)u(x+2)+a_1(x)u(x+1)+a_2(x)u(x) = 0."$$

Professor D. R. Curtiss: "On the real branches of implicit functions in the neighborhood of multiple points."

Mr. L. L. Dines: "A method of investigating numbers of the forms $6^\kappa \cdot s \pm 1$."

Professor L. E. Dickson: "Criteria for the irreducibility of a reciprocal equation."

Professor L. E. Dickson: "On reciprocal abelian equations."

Professor L. E. Dickson: "On the congruence $x^n + y^n + z^n \equiv 0 \pmod{p}$."

Professor Jacob Westlund: "Note on the equation $x^n + y^n = nz^n$."

Mr. F. H. Hodge and Mr. E. J. Moulton: "On certain characteristics of orbits for a general central force."

Professor G. A. Miller: "The central of a group."

Dr. A. E. Young: "On the problem of the spherical representation and the characteristic equations of certain classes of surfaces."

Dr. A. C. Lunn: "A continuous group related to von Seidel's optical theory."

Dr. A. C. Lunn: "A minimal property of simple harmonic motion."

Dr. A. C. Lunn: "The deduction of the electrostatic equations by the calculus of variations."

Mr. A. R. Schweitzer: "Remark on Enriques' review of the foundations of geometry."

Mr. A. R. Schweitzer: "On the calculi of relations, classes and operations."

Professor E. J. Wilczynski: "Projective differential geometry of curved surfaces, fourth memoir."

Dr. G. D. Birkhoff: "Irregular integrals of ordinary linear differential equations."

Professor R. D. Carmichael: "On the general tangent to plane curves."

Professor R. D. Carmichael: "On plane algebraic curves symmetrical with respect to each of two rectangular axes."

Professor O. D. Kellogg: "Note on the geometry of continuously turning curves."

Dr. I. Schur: "Beiträge zur Theorie der Gruppen linearer homogener Substitutionen."

Mr. W. D. MacMillan: "On the character of the solutions of homogeneous linear equations with periodic coefficients."

Mr. A. R. Schweitzer: "On the quaternion as an operator in Grassman's extensive algebra."

The next meeting of the section will occur in December, 1908.

H. E. Slaught,
Secretary of the Section

THE NEW YORK ACADEMY OF SCIENCES. SECTION OF ANTHROPOLOGY AND PSYCHOLOGY

In conjunction with the American Ethnological Society, a meeting was held on March 23, at the American Museum of Natural History.

Professor Arthur O. Lovejoy spoke on "Fire Cults: their Distribution and Characteristic Features, with a Hypothesis Respecting their Origin and Meaning." While the most wide-spread of the observances relating to the sacred fire is the custom of maintaining, either upon the domestic hearth or in a communal shrine, a fire that, except upon periodic ceremonial occasions, is never permitted to go out—a practise which by itself might be regarded as a mere convenience or necessity, invested in the course of time

with supernatural or magical import—there are other fire-observances, occurring usually among the same peoples, which also have a bearing on the significance of the fire-cult. Especially significant is the annual or cyclic ceremony of extinguishing the old fire and kindling new by some archaic method, as the central and most solemn rite in the transition to a new year—*e. g.,* at the planting of the first seed or the first eating of the new crop (Rome, Celtic Ireland, Eskimos, Iroquois, Muskoki, Aztecs, Ouichuas and others). Widely diffused are also the customs of passing new-born children over or around the fire (*cf.* Greek myths of children rendered immortal by this means); of leaping through fires at certain seasonal festivals, as the Roman Palilia, the Johannisfeuer celebrations, etc.; of employing fire as a fertility charm for crops and herds; of celebrating essential parts of the marriage ceremony before the household fire; of using fire in initiation rites. An analysis of these observances and a consideration of the reasons actually given for certain of them by Iroquois and Maori makes it probable that the sacred fire was by many races conceived, not as a practical convenience, nor as an unmotivated ancient custom, nor as a device for frightening away demons, nor as a negative purifying agency merely, but as a vehicle of life force or magical energy—*manitou, wakonda* or *mana;* that the health and prosperity of the household or tribe were believed to depend in part on the fire's perpetuity, vitality and purity; and that the fire, like all natural forces, was thought of as subject to periodicity, to a tendency to grow old and weak, and accordingly as in need of periodic renewal.

In a paper on "The Psychology of Dreams," Dr. Robert H. Lowie called attention to the services which scientific dream psychology can render to the ethnologist. A knowledge of the investigations carried on in this field will enable him to view critically the plausible but inaccurate dicta of popular psychology. Knowing, for example, the theory of dreams advanced by Delage, the ethnologist will not naïvely accept the assumption of Wundt and Radestock that dreams of recently deceased relatives have largely influenced the development of belief in a hereafter. A positive benefit is derived when mythological figures of obscure origin, such as dwarfs, gorgons, etc., are derived from the distorted images of some dreams—Wundt's Fratzenträume—as a conceivable source. From a purely psychological point of view, the speaker urged the desirability of fuller dream-records, especially in regard to varieties of hypnagogic experience.

R. S. WOODWORTH,
Secretary

THE GEOLOGICAL SOCIETY OF WASHINGTON

AT the 203d meeting of the society, on March 25, 1908, Mr. Willis T. Lee spoke informally regarding the "Local Upturning Sedimentary Rocks at their Outcrop." Grand Mesa in western Colorado rises 5,000 feet or more above the general surface to the south and west, and is surrounded by a steep escarpment. The general dip of the beds is 2.5°, but where they crop out in the sides of the mesa for a distance of 75 miles or more, the dip is often 5° to 8° or more. It is usually greatest in the projecting points and becomes less inward or toward the mesa, flattening to the general inclination of 2.5° within a distance varying from a few hundred feet to a quarter of a mile.

The upturned parts may represent the bases of eroded anticlines, monoclines or domes, but this suggestion is apparently invalidated by the occurrence of dip only toward the mesa and practically at right angles to the outcrop; or the phenomenon may be due to weathering of the exposed sediments combined with relief of pressure as the superincumbent rocks were eroded away. This finds support in the observation that the rocks are often most steeply upturned in the projecting points of the cliffs. On the other hand, it is not certain that relief of pressure would have any influence on the inelastic rocks, or that the shales underlying the beds in which the upturning is most conspicuous would expand on exposure to the weather. It is probable that hydration and carbonation of the rocks may account for the upturning.

Mr. D. B. Sterrett described the discovery of meerschaum in New Mexico, which is of interest since the world's supply, coming chiefly from Asia Minor, scarcely meets the demand. A chemical analysis, by Mr. George Steiger, of material from the Dorsey claim, twelve miles northwest of Silver City, corresponds very closely with the composition required by the formula generally given for meerschaum, that is, $2H_2O + 2MgO + 3SiO_2$. The mineral occurs in fissures, joints and seams in a magnesian limestone formation, probably of Ordovician age. Two varieties were observed, massive and nodular meerschaum. Only surface material was available for examination. This possessed many of the properties of ordinary meerschaum, including the important one of absorbing a mixture of wax and nicotine. On the other hand, the majority of the specimens examined were heavier than meerschaum ordinarily used for carving, and some of them contained tufts of fibrous material which made it difficult to work and polish.

Regular Program

The Intrusive Rocks of Mt. Bohemia, Michigan: Mr. Fred. Eugene Wright.

Mt. Bohemia is located near the end of Keweenaw Point, Michigan, and consists in large part of lava flows and interbedded conglomerates of the Keweenaw formation. On its south flank a peculiar intrusive rock mass is exposed which is unique in character and has long attracted the attention of geologists. Two rock types occur within this intrusive body—a dark, granitoid rock consisting chiefly of red, idiomorphic oligoclase (Ab_3An_2), pyroxene and magnetite in such proportions that chemically the rock is practically identical with the Keweenaw ophites. This rock was originally called *orthoclase gabbro* by Irving in his monograph on the copper-bearing rocks of the Lake Superior region, but the name *oligoclase gabbro* seems preferable in view of the fact that practically no free orthoclase is present in the rock. The second rock type is entirely surrounded by the first, and is brick red in color; qualitatively it consists of minerals identical with those of the enclosing oligoclase gabbro, its essential constituents being quartz and red idiomorphic oligoclase with subordinate amounts of the colored constituents. The alteration of the different constituents in the two rock types is characteristic and in every way similar, and substantiates the inference that they are genetically closely related, and that the red rock is an aplitic phase of the oligoclase gabbro. It may, therefore, be termed *gabbro aplite*. The position of the two rocks in the quantitative classification of Cross, Iddings, Pirsson and Washington is: for the oligoclase gabbro, Class III., Order 5, Rang 4, Subrang 3; in short, *Bohemial Auvergnose;* for the gabbro aplite, Class II., Order 4, Rang 3, Subrang 4 (*Bohemial Tonalose*). The geologic relations of the two rocks were discussed in detail with a view to a possible eutectic relation of the constitutents in the aplite which would then be the last to crystallize, and by a process of fractional crystallization be forced toward the center. By actual experiment, however, it was found that, on heating powder of both rocks in an electric resistance furnace for one hour at 1,132° C., the aplite had just begun to melt, while the oligoclase gabbro had only sintered slightly; while at 1,150°, under the same conditions, both the gabbro aplite and the oligoclase gabbro showed signs of fusion. (These temperature measurements were made by Dr. W. P. White, of the Geophysical Laboratory. His courtesy is herewith gratefully acknowledged.) This temperature range is so slight that the idea of eutectic relations in the dry melt is at least not strongly substantiated by experiment. The objections to any inference which might be drawn from the behavior of rocks of this type in the dry state were pointed out and the means for attacking such problems briefly indicated. The contact relations of the aplite to the oligoclase gabbro (change in granularity, etc.) were also briefly considered, together with the contact metamorphism of the adjacent ophites by the intrusive oligoclase gabbro.

Some Structural Details in the Pittsburg Region: Mr. G. C. Martin. (No abstract furnished.)

The Mapping of Landforms: MR. F. E. MATTHES.

An attempt is offered in this paper to place the mapping of landforms on a more rational basis than has obtained hitherto, and to establish such fundamental principles as may serve to guide the topographer in the judicious representation of the relief on reduced scales, and thus lead to greater uniformity and consistency of interpretation.

In the first place a thoroughgoing analysis and classification of landforms seems necessary for a general groundwork.

Beginning with the continent as the largest unit landmass, several primary subdivisions of a comprehensive nature—*physiographic provinces*—may first be blocked out. Each of these again may be divided into smaller tracts or *physiographic regions,* each of them a distinct physiographic unit. Thus the entire Appalachian complex, from the New England ranges down to Alabama, may be spoken of as a "province"; each of its subdivisions, like the Alleghany Plateau, the Ridge-and-Valley Belt, or the Piedmont Plateau, on the other hand, as a "region."

The character of the relief of a "region" varies, as a rule, considerably from one part to another, and further subdivision into *topographic districts* suggests itself; each district having a distinct and fairly uniform *topographic character* of its own. "Topographic character" as a specific term, therefore will be used as referring properly to topographic districts. Analyzing now what determines topographic character, we find that three factors enter into it: (1) the vertical measure of the relief, (2) the types of landforms represented, (3) the disposition or manner of assemblage of the topographic units.

For the topographer's purpose it is helpful to resolve the landscape into component landmasses each of which may be considered by itself as a topographic entity or unit. Thus each mountain, spur, ridge, hill, mesa, terrace, cliff, fan, flood-plane, dune, sink, moraine, drumlin, cirque, cone, etc., constitutes a topographic unit. Obviously there are as many different kinds of topographic units as there are types of landforms. Not only, but the units of a given type frequently occur associated in different sizes, and are therefore capable of being further classed by order of magnitude. Thus an entire mountain range, a single mountain on the same, a master spur of the mountain, a small spur of the master spur, a spurlet of the small spur, etc., constitute units of successively lower orders of magnitude, yet all belonging to the same type of stream-carved landforms. The topographic character of a given district then depends largely on the kinds and sizes of topographic units represented within its compass. Contiguous districts, however, characterized by the same topographic types and the same height of relief, may yet differ conspicuously in topographic character because of differences in the disposition of the units. A third factor must therefore be taken into account, namely, the disposition, grouping or manner of assemblage of the topographic units. This concept is covered for stream-dissected districts, by the term "*topographic texture,*" and the same may perhaps with propriety be extended to others not composed of units of stream-dissection, so that it will serve to designate the manner of assemblage of topographic units of *all* types. Thus a number of different textures may be recognized, such as coarse, fine, uniform, irregular, graded, homogeneous, heterogeneous, simple, intricate, linear, trendless, radial, peripheral, etc.

Starting with this classification of landforms and this concept of topographic character as a basis, it is now in order to proceed with the formulating of criteria for the use of the topographic delineator.

From the foregoing it follows at once that a map which aims to give an expressive representation of the relief must satisfy three conditions: (1) it must correctly indicate the measure of the relief; (2) it must faithfully delineate the true character, shape and size of each topographic unit; (3) it must be reliable as to the relative position and orientation of the units, that is, it must show the texture characteristic of each district.

These rules apply to all topographic maps, whatever the scale or the nature of the cartographic device used for the representation of

the relief (whether contouring, hachuring or shading).

A number of corollaries follow, a few of which will be cited:

Elimination of units too small for delineation should proceed by order of magnitude. In a consistent map units of a certain order should not appear in one place and be omitted elsewhere.

Elimination of units of one order should not result in the enlargement of those of a higher order. The delineation of the latter, in order to be expressive, should so far as possible *suggest* the presence and character of the detail suppressed.

Consecutive reductions in scale should carry with them elimination of correspondingly higher orders of units.

In conclusion, it may be stated that the practical application of these principles by the topographer in the field proves to lead to no revolutionary changes in mapping methods, but on the contrary confirms the soundness of the practise, intuitively established though it may be, for the most part, of our ablest modern cartographers.

RALPH ARNOLD,
Secretary

DISCUSSION AND CORRESPONDENCE

GEOLOGICAL CLIMATES

To the Editor of Science: Dr. Lane, in his interesting paper published in Science for April 10, urges certain readers not to accept my "*ipse dixit*" but rather to await further promised demonstration.

With the added evidence given in the last issue of Science (pp. 784–5) it seems hardly necessary to point out that, so far as theories relating to terrestrial phenomena are concerned, it now rests solely with the scientists to demonstrate, if possible, that some vital flaw exists in my published work; so long as this can not be done, "most modern theories of geological climate" must certainly be regarded as "upset," *for these theories are based upon an adopted value for the temperature of space which is* (according to my demonstration) *too great by nearly three hundred degrees of the centigrade scale* at the earth's distance from the sun; and this result is practically independent of the errors of observation, for even if we should assume the measured focal temperature to be one thousand degrees in error, the provisional value (1°.5) for the temperature of space would be altered only a degree or so.

My result for the absolute temperature of space is not a speculative one; until it is proved incorrect it must stand as a demonstrated fact which is in no way dependent on other demonstrations to be given "later on."

It may not be out of place to remark that by attaching too much importance to the occasionally unguarded assertions of great authorities we are apt to retard, or to discourage, original work along lines still demanding rigid investigation. That a purely empirical formula like Stefan's should, by common consent, be honored to the extent of being called a "law," is misleading; that one of our great living authorities should refer to "The establishment of Stefan's law"[1] is still more misleading.

For myself, the most remarkable feature of this whole controversy is the fact that it has escaped the attention of scientists that, on purely theoretical grounds, the results deduced with the aid of Stefan's formula (or any other formula except the Newtonian) can not be in agreement with the principle of the conservation of energy.

J. M. SCHAEBERLE

ANN ARBOR, MICH.,
May 18, 1908

"AMETHYSTINE BLUE."

To the Editor of Science: On page 825 of Science, May 22, 1908, Professor T. D. A. Cockerell calls attention to the development of the color of amethyst in glass exposed to strong light, and also mentions that this color is discharged by heat.

I am writing this brief note to call attention to the fact that the phenomena mentioned in Professor Cockerell's communication have long been known to chemists, and the explanation of same is very simple, viz., bottle glass is usually made of cheap raw materials,

[1] Science, March 27, p. 503.

and the sand used usually contains more or less iron. During the process of its manufacture the iron enters into the composition of the glass, and if present as a ferrous compound gives to the glass a green color. To dissipate the green color manganese peroxide is added to the melt for the purpose of oxidizing the ferrous iron to the ferric state. Under these conditions if only a small quantity of iron be present the pale yellow of the ferric salt will not be observed; besides, the yellow will be neutralized by the violet of the manganese salt, thereby producing a colorless glass. Now it is well known that glass decolorized with manganese slowly becomes red-violet when long exposed to light, but remains colorless when protected from the light. The phenomenon is merely an instance of chemical action in solid solutions; the effect of heat shows it to be a reversible reaction. The amethystine color is due to the presence of a manganese salt. Light promotes the development of the manganese salt; heat reverses the reaction.

HENRY WINSTON HARPER

THE UNIVERSITY OF TEXAS,
AUSTIN, TEXAS,
May 25, 1908

TO THE EDITOR OF SCIENCE: Professor Cockerell's note on the coloration of glass, published in SCIENCE of May 22d, seems to call for a word of discussion. It is not necessary to go to arid regions to observe the phenomenon. The globes of the street-lamps used in the City of Philadelphia, colorless when first put up, become in the course of two or three months distinctly violet, and in a year very strongly so. That the effect is the direct result of exposure to sunlight is proved by the fact that those surrounded by trees require a much longer time for the appearance of the color.

As to recent literature on the subject, five or six extensive papers, as well as several brief notes, have appeared within the last three years; it seems unnecessary to give a list of these here, as they are fully recorded by Mr. Ross A. Gortner.[1] The general conclusion from these various studies is that the development of the color is due to the oxidation of the manganese in the glass, although the exact mechanism of the change is not understood. Whether the tints produced in a great variety of substances by exposure to radium preparations are of the same character as those brought about by sunlight and ultraviolet light in glasses has never been definitely ascertained; but it appears more probable that they belong in the class of colloid colors, such as the red of glass containing metallic gold, the blue of sodium chloride heated in sodium vapor, and, possibly, the violet of the amethyst-quartz found in nature.

EDGAR T. WHERRY

PHILADELPHIA, PA.

THE ITALIAN ARCHIVES OF BIOLOGY

TO THE EDITOR OF SCIENCE: The publication of the *Archives Italiennes de Biologie*, founded by Professor Mosso, after having reached forty-eight volumes and its twenty-fifth year met with a grave interruption in its career, owing to the strike of the typographers at Turin, and it has been found necessary to make new arrangements for the continuation of the journal. The next number is shortly to be issued under the auspices of the new administration. The publication remains, as in the past, under the direction of Professor Angelo Mosso, with Professor V. Aducco and Professor U. Mosso as coeditors. It will still have the cooperation of biologists in sundry Italian universities. The original articles and summaries published in the *Archives* represent faithfully the progress of biology each year in Italy. The appearance of the journal will be improved, and the editors make an appeal for increased support from America. The publication has acquired a high standing and ought certainly to be among the journals taken by every university in the country. The subscription price is 40 frs. for the two annual volumes. Subscriptions should be sent to the

[1] "Some Effects of Sunlight on Colorless Glass," *American Chemical Journal*, Vol. 39, 1908, 157–162.

Administration des Archives Italiennes de Biologie, Via Acquarone, Genova, Italy.

Charles S. Minot
Harvard Medical School,
May 29, 1908

SPECIAL ARTICLES

AN INTERPRETATION OF ELEMENTARY SPECIES

The original idea which led to the development of the theory of so-called elementary species is found in Darwin's gemmules. Existence of these gemmules was proposed to explain the supposed transmission of acquired characters. Weismann, acting on Darwin's idea as a suggestion, developed a very elaborate theory of heredity. To consider the relation of Weismann's philosophy to the subject in hand would take us too far from our present object, though this relation is important. De Vries, going directly back to Darwin and doing away with that part of Darwin's theory which postulated the migration of gemmules of the various cells of the body to the germ cells and assuming that the germ plasm is composed of these gemmules—or as de Vries calls them, pangens, has developed a very elaborate theory, not only of heredity, but also of evolution, based on the assumption that the individual is merely an assemblage of parts, each of which constitutes an hereditary character and each of which develops from a particular pangens in the original germ plasm of the fertilized egg. He conceives a definite species to be made up of a definite number of these hereditary characters. The addition of a new kind of pangens to the germ plasm causes the developed organism to differ more or less from other individuals which preceded it. If this difference relates to a single pangens, then the new and modified form of the organism is looked upon as an elementary species. It differs from its congeners by an elementary difference. The ordinary species may contain within it a large number of elementary species, each differing from those nearest related to it by the possession of a single pangens not possessed by its nearest relatives.

The work of Nilsson in Europe and of Shull in this country have been considered as strengthening the idea of elementary species. Nilsson has been able to obtain varieties of wheat and other plants that may be assumed to be absolutely uniform except for such differences as are caused by environment. Some of the distinct strains differ very little, but this difference is absolutely constant, and the different individuals within one of the elementary species are as like each other as so-called identical twins. They offer no further chance of improvement by selection. Shull has, in like manner, obtained supposedly elementary species of corn which breed true, the various individuals of a given strain being as much alike as identical twins. He was led to look upon a corn field as simply a heterogeneous collection of these elementary species and hybrids between them.

These so-called elementary species can easily be accounted for on the old Darwinian idea of gradual evolution, as will be shown below. They are, therefore, in no wise a confirmation of the pangens theory of de Vries. The demonstration is as follows: Let A, Table I., represent a Mendelian character which is more or less variable in the different individuals in which it appears, these differences being hereditary. Let B and C represent other Mendelian characters similarly variable. The variations in these characters may have come about gradually, as Darwin supposed variation to occur, or they may have come about in any other manner. Suppose A^1 represents the first character as it appears in a particular homozygous individual. A^2 may represent this same character in another homozygous individual, the difference between A^1 and A^2 being so slight as not to be certainly discernible. In like manner A^3 differs from A^2 so slightly that the two can not be certainly distinguished, but A^3 differs from A^1 sufficiently to be distinguished. So with the other A's. Any one of them in the series from A^1 to A^{10} differs so slightly from adjacent A's as not to be certainly distinguishable from them, but may be distinguished with more and more certainty as we recede from the selected A in the series. The exponents of B and C have

a similar meaning. While we have assumed the series A^1 to A^{10} to be continuous, this series may have gaps in it not bridged over by *living* intermediate forms. Each of these "allelomorphs" is supposed to be phylogenetically related to the others in the same series, and the differences between them may be supposed to be analogous to the differences between the individuals of a large and variable species. We have merely taken the case in which the series is continuous to show that such continuity is consistent with the phenomena under consideration.

TABLE I

A^1	A^2	A^3	A^4	A^5	A^6	A^7	A^8	A^9	A^{10}
B^1	B^2	B^3	B^4	B^5	B^6	B^7	B^8	B^9	B^{10}
C^1	C^2	C^3	C^4	C^5	C^6	C^7	C^8	C^9	C^{10}

TABLE II

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A^1A^5:	A^1	A^1	A^1	A^1	A^5	A^5	A^5	A^5
B^3B^8:	B^3	B^3	B^8	B^8	B^3	B^3	B^8	B^8
C^2C^6:	C^2	C^6	C^2	C^6	C^2	C^6	C^2	C^6

TABLE III

(1) × (1)	A^1A^1,	B^3B^3,	C^2C^2.
(2) × (2)	A^1A^1,	B^3B^3,	C^6C^6.
(3) × (3)	A^1A^1,	B^8B^8,	C^2C^2.
(4) × (4)	A^1A^1,	B^8B^8,	C^6C^6.
(5) × (5)	A^5A^5,	B^3B^3,	C^2C^2.
(6) × (6)	A^5A^5,	B^3B^3,	C^6C^6.
(7) × (7)	A^5A^5,	B^8B^8,	C^2C^2.
(8) × (8)	A^5A^5,	B^8B^8,	C^6C^6.

Under our hypothesis all the various forms of A will be allelomorphic; likewise those of B and those of C. In order to have a concrete case, suppose that the three characters considered are characters of the corn plant. A may govern the length of the tip on the corn husk, the various exponents indicating the relative development of this tip. B may represent breadth of leaf and C length of internode. It is to be understood, of course, that we are referring now only to differences which are hereditary and our exponents refer to degrees of difference which are hereditary. Now let us select an individual corn plant at random from a field. Suppose the gametic constitution of the plant selected is that shown in the first column of Table II. With reference to the length of the husk tip it is heterozygote, one of the allelomorphs tending to produce a very short tip, the other a tip of medium length. With reference to the breadth of leaf, our selected plant is also heterozygote, one of the allelomorphs tending to produce a moderately narrow leaf, the other a moderately wide leaf. With reference to the length of internode, the allelomorph C^2 would correspond to a short internode, while C^6 corresponds to a moderately long one. Now on the well-known behavior of Mendelian character pairs, when our corn plant, after close fertilization, produces reproductive cells, we shall obtain, with reference to the three characters considered, eight types of gametes, as shown in Table II. The fortuitous union of these eight types of gametes produces sixty-four fertilizations, consisting of twenty-seven different types, eight of which are homozygote with reference to each of the characters concerned. These eight homozygote types are shown in Table III. Now, if we neglect any evolutionary changes which may have occurred in each of these hereditary characters during one generation, each of these types shown in Table III. will reproduce so true to type that there will be no variation at all except that due to environment; and we have eight so-called elementary species, each reproducing as true to type as branches from the same twig of an apple tree.

It is very clearly seen that each of these elementary species is merely a cross-section of the real variable species, and that the major part of the variation in a corn field is accounted for simply as a result of the recombination in each generation of Mendelian characters, each of which may vary between wide extremes just as a species varies under the Darwinian theory of evolution. For instance, the first elementary species in Table III. is a cross-section of the species through A^1, B^3 and C^2 of Table I.

By properly selecting the parent plant we could get other so-called elementary species intermediate between any two of those shown in Table III. An interesting example of this arose at the recent meeting of the American Breeders' Association. Dr. Shull reported his

work in which he had selected out the elementary species produced by a self-fertilized corn plant. With reference to number of rows of grain on the cob some of the forms he happened to get showed a strong tendency to produce ears with ten rows and others with fourteen rows. None had twelve for their mode, and he had been led to the belief that amongst the elementary species of corn none of them, when purely homozygote, tends to produce twelve rows. Dr. E. M. East, of New Haven, who had done some similar work, had happened to get a cross-section of the species which tended strongly to produce twelve rows and not ten or fourteen, which is just what one would expect if the present view of elementary species is correct.

Under this view, a so-called elementary species is simply a completely homozygous form, which necessarily reproduces itself with almost absolute fidelity. The number of such forms possible in a species depends on the number of independent Mendelian characters present, and the degree of variability of these characters. The various forms under which one of these characters exhibits itself may represent a continuous series such as we have assumed above, or the series may be broken at various points, leaving gaps which are bridged only in the ancestral lines of the allelomorphs having a common descent, just as we find the case to be with large and variable groups of organisms.

It is seen, therefore, that if Darwin's idea of the manner in which evolution occurs is true, then *the results secured by the breeder of so-called elementary species are a necessary result of Mendelian behavior of Darwinian characters.* The remarkable fidelity with which so-called elementary species reproduce themselves is thus seen to be in entire accord with the theory of gradual variation taught by Darwin.

The work of Nilsson, Shull, East and others who have segregated these forms that propagate as true to type from seed as cuttings, is of great importance to biological theory, as well as to the art of the breeder. Nilsson is making commercial use, on a large scale, of the principle involved. Tracy, in breeding seedling varieties of cassava, is doing the same thing on a smaller scale, though his work is only just beginning to show positive results. The seedlings of the cassava plant are ordinarily about as variable as those of the apple. Some three years ago, Professor S. M. Tracy, at the request of the writer, undertook to secure homozygote forms of cassava at Biloxi, Miss. He now has a few varieties nearly completely homozygote, and it is believed that within one or two seasons their culture on a commercial scale will be an accomplished fact. This, it is hoped, will rejuvenate an industry which had died because of the uncertainty of propagating cassava from cuttings.

At least in self-fertilized species, these completely homozygote forms offer splendid material for studying evolutionary changes, and especially for studying those changes induced by change of environment. They should soon become the starting point for some fundamentally important investigations.

W. J. Spillman
U. S. Department of Agriculture

CURRENT NOTES ON METEOROLOGY AND CLIMATOLOGY

KASSNER'S "DAS WETTER"

A very useful little book has just been published by Professor Carl Kassner, observer at the Royal Prussian Meteorological Institute in Berlin, and Privatdocent at the Technische Hochschule in that city ("Das Wetter, und seine Bedeutung für das praktische Leben," 8vo, Leipzig, Quelle und Meyer, 1908, pp. 148). The plan of the volume is rather different from that of other books dealing with the same subject. Its aim is to set forth, for the information of the average reader: (1) The historical development of weather forecasting; (2) the basis of modern weather forecasting and (3) the relations of the weather to the every-day life of man. The section dealing with the historical development of forecasting summarizes briefly the results of Hellmann's investigations into meteorological folk-lore and literature. Special attention may be directed to the third section, which is

an innovation in meteorological text-books, dealing with the importance of weather conditions in practical life. Professor Kassner has collected and classified a considerable number of illustrations of the relation of weather conditions to man's life, activities and health. Many of these examples are not new to those who have worked along the same lines, but the collection of such illustrations will make them widely useful. Professor Kassner has given us a book which occupies a unique field. The low price of the volume (1 Mark, 50 pf.) brings it within reach of a large number of persons.

LAKE CHAD—ITS DESICCATION

IN a recent address entitled "From the Niger to the Nile" (*Scot. Geogr. Mag.*, Jan., 1908), Lieut. Boyd-Alexander noted the supposed decrease in the area of Lake Chad. It is his opinion that the lake does not alter much in size, and that the supposed greater original area is due partly to inaccurate surveying and partly to the fact that certain villages are several miles distant from the lake, giving the impression that they were formerly on the lake shore. The position of these villages, Lieut. Boyd-Alexander believes, is due to the danger of flooding during the blowing of the Harmattan, which causes the water to flow 600 yards over the land with an ordinary wind, and drives it as far as two miles when the wind is strong. Where there are good banks, and where the water is not influenced by the prevailing winds, there are many villages close to the lake. A chain of islands, once separate and now more or less joined by a marsh, has also given the impression of increasing aridity, but this change may very likely be due to the silting of mud and sand against the obstruction of the islands by the opposing influences of the Yo and the Shari, the two rivers that feed the lake.

A RAILWAY WIND GAUGE

SINCE September, 1903, a wind-gauge has been set up near Ulverston, in England, to protect trains from risk in crossing a very exposed viaduct. The apparatus is fixed at the west end of the Levens viaduct. Its actuating part consists of two boards, kept in a vertical position by springs, and the movements of which are shown on a chart by means of the customary pen and clockwork appliances. A pen is operated by either board according to the direction of the wind, and for greater exactitude of time, the chart-paper, over sixty-five feet long, is perforated, the holes in the paper corresponding with studs in the clockwork wheel. When the wind pressure reaches 32 pounds to the square foot the spring-boards referred to are adjusted to make an electrical contact, ringing bells in the signal cabins on either side of the viaduct. When this occurs, all trains are detained until the force of the wind moderates. Any such interruption is telegraphed to the superintendent of the line. In February, 1907, a velocity calculated as equivalent to 65 miles an hour was recorded.

THE MOON AND CLOUDS

J. R. SUTTON, meteorologist of the De Beers Consolidated Mines, at Kimberley, South Africa, writes "On the Lunar Cloud-Period" in the *Trans. So. Afr. Philos. Soc.*, Vol. XVIII., Part 3, Dec., 1907. The cloud observations at Kimberley have been worked up for eighty-seven lunations, from January 1, 1900, to January 13, 1907. The inference which the author thinks may fairly be drawn from his results seems to be that if the results "do not go far enough to prove that there is a lunar influence over the clouds, they do not prove that there is not. There are, at any rate, a number of interesting coincidences which seem to be worth elucidation."

MOUNTAIN SICKNESS

IN a recent paper on "Mountain Sickness and its Probable Causes," by T. G. Longstaff (Spottiswoode and Co.), the author gives abstracts from the accounts of high mountain-climbing expeditions, and includes the experiences of aeronauts during high balloon ascents, the results of experiments in pneumatic chambers, and his own observations. He believes that mountain sickness is produced by (1) mountain lassitude, due to imperfect oxygenation, and (2) by excessive fatigue and exhaustion.

LONDON FOG AND COUNTRY FOG

London fogs are often very thick; very dark, of the "pea-soup" variety; and very "dry." Fogs in the surrounding country at the same time are clean, white and wet. The difference is largely a question of the impurities, the "dust" of various kinds, in the air of the city. In *Symons's Meteorological Magazine* for December, 1907, a recent case of this kind is noted. On November 11, in the evening, there was a thick, dry fog, "with the pungent fumes of oxide of sulphur very noticeable" in London. Fifteen miles out of the city the fog was white and extremely wet.

NOTE

With the present number of Science, the publication of these "Current Notes on Meteorology and Climatology" ceases, so far as the undersigned is concerned. This step has become necessary owing to the increasing pressure of other work whose accomplishment is imperative, and for reasons of health which can not be disregarded.

Since the first publication of these "Notes" on May 1, 1897, they have appeared in 166 numbers of Science, on 721 separate topics. In addition, 19 book reviews and 7 short communications on meteorological subjects have been contributed by the writer during the same period.

If during the past twelve years the undersigned has been able, in some slight way, through these "Notes" to help his fellow workers in meteorology and climatology, and in science generally, to keep up with the more important advances in the science of the earth's atmosphere, he will feel well repaid for his labors.

Robert DeC. Ward

Harvard University,
Cambridge, Mass.,
April 27, 1908

LETTERS CONCERNING THE ADMINISTRATION OF SYRACUSE UNIVERSITY

Garrison-on-Hudson, N. Y.,
May 23, 1908.

Chancellor James R. Day,
Syracuse University, Syracuse, N. Y.

Dear Sir: I have received from Dean Kent a statement in regard to his dismissal from Syracuse University. It appears that you are unwilling to give the reasons for this action beyond the statement that he has been a disappointment to the administration and is *non grata* to the chancellor. It is obvious that a dean should work in harmony with the head of a university, and that there should be courtesy and consideration on both sides. If, however, a dean or a professor is placed in a position of subservience to the president, so that he has no freedom or initiative in his own department, or if he may not freely present his views to the president and to his colleagues, then his position is not tolerable, and no man of ability and independence would willingly accept a position in a university in which such conditions obtained. I do not mean to imply that there is such a deplorable state of affairs at Syracuse, but the dismissal of Dean Kent without a full statement of the grounds seems to confirm the reports that I have received from other sources to the effect that the chancellor regards deans and professors as subject to his individual will.

I venture in the interests of higher education to ask: (1) The grounds leading to the dismissal of Dean Kent; (2) Whether it is true, as alleged, that a professor who should show sympathy with Dean Kent would be liable to dismissal, and (3) whether you regard it as proper to dismiss a professor, if such action would not have the approval of his colleagues on the faculty.

I assume that I may print this letter and your reply in Science.

Very truly yours,
J. McK. Cattell

Garrison-on-Hudson, N. Y.,
May 29, 1908.

Chancellor James R. Day,
Syracuse University, Syracuse, N. Y.

Dear Sir: I regret that your reply to my letter may not be printed, as it is a clear statement of the policy of academic administration which obtains widely in this country. I myself believe that this policy—according to which the president has autocratic control, subject only to an absentee board of trustees

receiving its information from him alone—is subversive of true university ideals. If all American universities should adopt such methods, we must look elsewhere for our best moral, social and intellectual life. If certain institutions only follow them, they will find it increasingly difficult to fill their chairs with men of the best type and indeed to maintain themselves as universities in the proper sense. You say: "Our professors have nothing to do with the hiring, continuing or dismissing of professors or students." This may be your law and policy, but it is not true as a matter of fact. There is a developing group consciousness among scientific and university men, which will make it difficult to fill properly a chair made vacant by methods that they do not approve.

Very truly yours,
J. MCK. CATTELL

THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH

MR. JOHN D. ROCKEFELLER has offered to give $500,000 for a hospital to be erected in connection with the Rockefeller Institute. It is understood that the necessary endowment will be provided when the hospital is ready. The letter from Mr. John D. Rockefeller, Jr., to Dr. L. Emmet Holt, secretary of the board of directors, is as follows:

Understanding that in the judgment of your board a hospital building is desirable in order to facilitate the work of research for which the institute was founded, my father will provide for the purchase of land and the erection and equipment of a suitable hospital building, whatever amount may be necessary, up to a total of $500,-000, payments to be made as the work progresses.

My father thus enlarges the scope and possibilities of the institute in grateful recognition of the services of Dr. Simon Flexner, as director, rendered in those orderly and progressive scientific investigations, which, sanctioned and encouraged by your board, and aided by learned associates and assistants, led him at length to the discovery of a cure for epidemic cerebro-spinal meningitis.

DARWIN CELEBRATION

THE American Association for the Advancement of Science will devote one day during convocation week next at Baltimore to the celebration of the centennial of the birth of Charles Darwin (February 12, 1809) and the semicentennial of the publication of the "Origin of Species" (November 24, 1859). The program so far as arranged is as follows:

Introductory remarks by the president of the association, T. C. Chamberlin, University of Chicago.

"Natural Selection from the Standpoint of Zoology," by Edward B. Poulton, Oxford University.

"Natural Selection from the Standpoint of Botany," by John M. Coulter, University of Chicago.

"The Direct Effect of Environment," by D. T. MacDougal, Carnegie Institution of Washington.

"Mutation," by C. B. Davenport, Carnegie Institution of Washington.

"The Behavior of Unit Characters in Heredity," by W. E. Castle, Harvard University.

"The Isolation Factor," by David Starr Jordan, Stanford University.

"Adaptation," by C. H. Eigenmann, Indiana University.

"The Bearing of Recent Cytological Studies on Heredity and Evolution," by E. B. Wilson, Columbia University.

"Evolution and Psychology," by G. Stanley Hall, Clark University.

"Recent Paleontological Evidence of Evolution," by Henry Fairfield Osborn, Columbia University.

In the evening a dinner will be given, after which certain addresses of a more general nature will be given. It is proposed to print these addresses in a volume to appear during the centennial year.

SCIENTIFIC NOTES AND NEWS

AT the meeting of the American Medical Association held this week at Chicago the following distinguished foreign men of science are announced to present papers: Dr. A. E. Schaefer, professor of physiology in the University of Edinburgh; Dr. C. E. Beevor, last year president of the London Neurological Society; Dr. E. T. Collins, lecturer on ophthalmology at the Charing Cross Hospital and Medical School; Dr. August Martin, professor of gynecology at Greifswald, and Dr. E. F. Sauerbach, professor of surgery at Marburg.

At the annual meeting of the American Association of Pathologists and Bacteriologists, held in Ann Arbor, Mich., on April 17 and 18, Dr. Harold C. Ernst, of the Harvard Medical School, was elected president.

Columbia University has conferred the degree of doctor of science on Professor Charles F. W. McClure, professor of comparative anatomy at Columbia University.

The Boylston Medical Prize for 1908 has been awarded by Harvard University to Professor James Homer Wright for an essay entitled "The Histogenesis of the Blood-Platelets."

Professor Otto Bütschli, of Heidelberg, and Professor A. G. Nathorst, of Stockholm, have been elected foreign members of the Linnean Society, London.

Dr. W. N. Shaw, F.R.S., has been elected a member of the Athenæum Club for "distinguished eminence in science."

At the annual meeting of the Harvey Society, held May 15, 1908, the following officers were elected for the coming year: *President,* James Ewing; *Vice-president,* Simon Flexner; *Treasurer,* Edward K. Dunham; *Secretary,* F. C. Wood; *Council,* Graham Lusk, S. J. Meltzer, Adolf Meyer. The society adopted a resolution as follows:

Resolved, That, in the desire of Dr. Graham Lusk not to undertake again the duties of president of the Harvey Society, its members express to him their cordial appreciation of the great value of his services to the medical sciences in this country in founding the society, in successfully administering its affairs during its early growth, and in placing it upon a substantial basis. The place now occupied by it abundantly demonstrates the wisdom of Dr. Lusk in organizing a medium of communication between the laboratory and the medical practitioners; and whatever the society shall accomplish in the future will be due in no small part to the worthy example which he has set.

The annual meeting of the International Association of the Marey Institute will be held at Paris on June 8. The following physiologists have undertaken to give demonstrations: Messrs. Barcroft, Bull, Carvallo, Demoor, Grutzner, Hurthle, Lapicque, Nogues, Pachon, Phillippson, Tchiriew, Tissot, Weiss of Koenigsberg, Weiss of Paris, Zwaardemaker.

The Sigma Xi Society, of the University of Chicago, held its regular spring meeting on May 19, 1908. Five new members were admitted to the society. Professor J. U. Nef gave the address of the evening upon "The Chemistry of the Sugars from the Standpoint of Methylene-dissociation."

The eleventh annual meeting of the Medical Library Association was held in the John Crerar Library and the Chicago Public Library on June 1, under the presidency of Dr. George Dock, of the University of Michigan.

Mr. Herbert L. Bridgman represented the United States at the International Polar Congress, which convened at Brussels on May 29.

Dr. C. F. Wahrer was elected president of the Iowa State Medical Society, at the session held at Des Moines on April 22.

Dr. R. P. Hibbard, soil bacteriologist of the Bureau of Plant Industry, has been elected to the position of soil bacteriologist and plant pathologist in the Mississippi State Experiment Station. He will have charge of the new department from June 1.

Dr. Adolph Cluss, professor of agricultural chemistry and technology in the Imperial Agricultural High School of Vienna, Germany, is visiting the colleges of agriculture and experiment stations of the United States.

On May 21, Dr. Alexander Scott gave the first of a course of three lectures at the Royal Institution on "The Chemistry of Photography."

Professor William Arnold Anthony, since 1894 professor of physics and electrical engineering at the Cooper Union, New York, died on May 29, at the age of seventy-three years.

Mr. Francis B. Forbes, author of a work on the flora of China, died in Boston on May 21, at the age of sixty-eight years.

Drs. Raikes and Wray, government medical officers at Singapore, have died of plague

contracted while performing a post-mortem examination on a patient who had died while in quarantine.

DR. CHARLES JAMES CULLINGWORTH, an eminent British gynecologist, author, among other works, of a biography of Oliver Wendell Holmes, died on May 11, at the age of sixty-seven years.

THE Rev. Father Eugene Lafont, for many years professor of physical science at St. Xavier's College, in India, has died at the age of seventy-one years.

THE death is also announced of Mr. Caleb Barlow, chief preparator of fossils in the British Museum (Natural History), and of Dr. Gustav Guldberg, professor of anatomy at Christiania.

THE Fifth Pan-American Medical Congress will take place in Guatemala, C. A., this year from August 5 to 8, inclusive.

A BRAZILIAN psychiatrical, neurological and medicolegal society has been organized. Meetings are held monthly at Rio de Janeiro at the National Hospital for the Insane. Professor J. Moreira is the first president of the society.

PROFESSOR A. E. VERRILL, of Yale University, has sold to that university his very valuable collection of marine invertebrates, acquired during his work for the U. S. Fish Commission from 1873 to 1887. The collection is the duplicate of one secured at the same time and since transferred to the National Museum at Washington.

PRESIDENT ROOSEVELT has signed the act providing for an area of twenty square miles in Montana for a range to maintain the American bison. This area the government will buy and fence, while the people are invited to subscribe for the purchase of the animals.

THE act making appropriations for the legislative, executive and judicial expenses of the government for the year ending June 30, 1909, which includes the appropriations for the United States Bureau of Education, provides for an increase of only $1,250 over the amount for the current year. The additional amount includes an increase of $1,000 in the salary of the Commissioner of Education, making it $4,500 per annum; also an increase of $250 in the appropriation for books for the library, current educational periodicals, other current publications, and completing valuable sets of periodicals, making the amount available for such purposes, $500. No appropriation whatsoever was made for the investigation by the Bureau of Education of special educational problems, for which purpose the secretary of the interior strongly requested an appropriation of $40,000.

PRESIDENT ROOSEVELT has suggested to Congress the appropriation of $20,000 for the salaries and expenses of three commissioners and a secretary, who shall for this government inquire into the opium evil. A letter from Secretary Root, accompanying the president's note, suggests that each country which has signified to the United States its willingness to make such an investigation appoint commissioners who shall make inquiries in their own countries. He further proposes that all these commissioners meet at Shanghai, China, on January 1, 1909.

A CONFERENCE of representatives of the United States Department of Agriculture and of the agricultural experiment stations of several states to consider plans for supplying serum for the prevention and treatment of hog cholera was held at Ames, Iowa, on May 28. The department was represented by Secretary of Agriculture James Wilson, Dr. A. D. Melvin, chief of the Bureau of Animal Industry, and Dr. M. Dorset, chief of the biochemic division of that bureau, and invitations have been extended by the department to the experiment stations of a number of states convenient to the place of meeting to send representatives. The conference took place on a farm which has been used by the Bureau of Animal Industry for experimental work with hog cholera for several years.

A REPORT on a study of an unusual collection of fossil fish from Ceará, a state of northern Brazil, by Dr. David Starr Jordan and John Caspar Branner, of Leland Stanford University, has been published by the Smith-

sonian Institution. The study was made under the assistance of a grant from the institution. The collection was taken from sandstone layers of the Cretaceous period.

The authorities of Peabody Museum, of Yale University, have made arrangements for securing additions to the mammal collection through Captain B. D. Cleveland, who commands a vessel soon to sail from New Bedford, Mass., on a voyage to Kergulen Island in the Antarctic Ocean.

Dr. Hamilton Rice, of Boston, who has returned from an eighteen months' trip to the headwaters of the Rio Negro, in Colombia, has given to the Peabody Museum, of Harvard University, a valuable collection of ethnological material which he obtained from the natives of the region around the upper Uaupes River. The collection includes dance costumes, feather, headdresses, rattles, whistles, drums and other paraphernalia used in their dances and ceremonies, blow guns with poisoned arrows, ordinary bows and arrows, ceremonial staffs used for carrying the heads of the enemy, and various household objects such as wooden seats, hammocks, baskets, etc.

UNIVERSITY AND EDUCATIONAL NEWS

Mr. James A. Patten, of Chicago, has given $150,000 to Northwestern University for a gymnasium.

The Sheffield Scientific School of Yale University has purchased a site at the end of Rocky Beach off Bradley Point, Savin Rock, on which an experiment and collecting station will be erected. During the past year the school voted to support a table at the Marine Biological Laboratory, and the structure at Bradley Point is intended for the use of experimenters during the months of the college year when Woods Hole is not accessible.

The American Ethical Union's summer school of three weeks, usually held at Plymouth, Mass., will this year be held at Madison, Wis. The school will be opened on July 5, in the Historical Library, and will include a series of forty-five lectures. Among the speakers are Dr. Henry Neuman and Percival Chubb, of New York University; Dr. David S. Muzzey, Dr. John L. Elliott, and Mrs. Anna Garlin Spencer, of the New York Ethical Culture School; William Mackintire Salter, of Cambridge; Professor Nathaniel Schmidt, of Cornell; Professor Charles Zueblin, of the University of Chicago, and Dr. Henry Moskowitz and Leslie W. Sprague, of the New York Ethical Society.

Dr. Walter R. Crane, instructor in the department of mining of Columbia University, has been elected professor of mining and dean of the school of mines of the Pennsylvania State College.

Robert M. Yerkes, A.B. (Ursinus), 1897, and A.B. (Harvard), 1898; Ph.D. (Harvard), 1902, has been promoted to be assistant professor of comparative psychology at Harvard University.

Instructors at Cornell University have been appointed as follows: F. A. Molby, G. W. Naysmith, A. A. Somerville and O. Tugman, in physics; F. D. Shetterly, in chemistry; C. A. Stewart, in geology; J. P. Schaeffer, in anatomy; W. C. Capron, in machine design; M. C. Earnsberger, in power engineering; G. D. Conlee, in experimental engineering, and J. N. Frost, in veterinary surgery.

The following appointments have been made at the University of Cincinnati: Instructors: Biology, Harry L. Wieman; mathematics, C. N. Moore; physics, Taylor S. Carter. The terms of R. E. C. Gowdy, Hanna fellow in physics; L. D. Peaslee, teaching fellow in zoology, and L. W. Sauer, teaching fellow in botany, have been renewed for 1908–09.

At the North Dakota Agricultural College: Firman Thompson, instructor in agricultural chemistry, has resigned to accept a position at the Delaware Agricultural College. Professor H. L. White, of the Medical College of the University of Vermont, has been elected as assistant professor of physiological chemistry and toxicology, and J. W. Ince, instructor at McGill University, has been elected instructor in agricultural chemistry.